SEMA technology promises to boost performance of hybrid electric vehicles

OAAT ACCOMPLISHMENTS

Segmented Electromagnetic Array (SEMA) Technology

Challenge

Small, low-cost electric motors are critical to enabling hybrid electric vehicles to achieve greatly increased fuel economy and significantly reduced emissions over conventional vehicles. The current technology presents challenges in size, efficiency, and cost. Advanced electric motors can assist with increased power demands during hard driving, replace the engine as the sole motive force during periods of low power demand and low engine efficiency, and capture energy through regenerative braking.

The focus of the development effort discussed below is to produce a production prototype and develop the manufacturing process for 30-kW motors at a unit cost of less than $450. A second design and similar process will be developed for 15-kW motors at a unit cost of under $230.

SEMA Technology was tested in the University of Tennessee's FutureTruck.

Technology Description

Under the Automotive Electric Motor Drive Program, an industry team comprised of Lynx Motion Technology, Delco Remy International, Visual Computing Systems, Inc., and Electricore is developing segmented electromagnetic array (SEMA) technology. Team members will work closely with an Automotive Integrated Power Module (AIPM) supplier to ensure system compatibility.

Patented SEMA coil design.

Accomplishments

During FY 2000, a proof-of-concept 30-kW motor was built and tested in a hybrid vehicle as part of the FutureTruck program by the University of Tennessee. Motor performance was verified on a dynamometer at Delco Remy.

The SEMA coil electromagnetic design is being optimized for performance and cost using computer-aided analysis tools. The next-generation 30-kW motor is being designed to improve reliability, manufacturability, and serviceability and to simplify housing design. The mass and volume of the motor have been reduced 14% and 26% respectively. Alternative designs are being evaluated to improve heat transfer, reduce magnet oxidation, and increase terminal inductance. The motor will use field serviceable bearings and sensors.

Manufacturing equipment is also being designed to simplify the pilot manufacturing process and allow in-house manufacturing capability for all critical parts.

A gap analysis has been performed for the 30-kW series hybrid and 15-kW parallel hybrid machines.

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Benefits

The SEMA motor/alternator is a major innovation in electromagnetic design. The axial-flux motor has an inherent geometric advantage in specific torque over radial-flux designs.

The high level of cooperation between the AEMD and AIPM programs will ensure that the motor will function successfully as an integrated drive system.

Delco will ensure that cost and reliability issues will be addressed properly to meet the needs of the marketplace.

Awards

Visual Computing Systems, Inc. received a 2000 Tibbetts Award for its work on segmented electromagnetic array brushless motors. Tibbetts Awards are made through the U.S. Small Business Administration for very innovative work under the Small Business Innovative Research Program. The awards represent the best of these research efforts.

Future Activities

The second-generation proof-of-concept 30-kW motor will be built and tested at Delco Remy. Pilot manufacturing processes will be used to develop proof-of-product 30- and 15-kW motors early in 2002.

Partners in Success

- Delco Remy International, Inc.
- Electricore, Inc.
- Lynx Motion Technology
- Visual Computing Systems, Inc.